MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1 2018/2019

TRT 3241- REAL-TIME SYSTEMS

(All sections / Groups)

18th OCTOBER 2018
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This examination paper consists of 4 pages (including the cover page) with 5 questions only.
2. All questions carry equal marks. The allocation of marks for each question is given in the paper.
3. Answer **ALL** questions.
4. Write your answers in the answer booklet provided.

Question 1 [10 marks]

a) Identify the key differences between hard real-time systems, soft real-time systems, and firm real-time systems.

[3 marks]

b) Describe **THREE (3)** components of kernel in real-time operation system.

[3 marks]

c) Discuss **FOUR (4)** characteristics of real-time embedded systems.

[4 marks]

Question 2 [10 marks]

a) The following statements represent functional requirements of a typical traffic intersection control system:

- A given traffic light will normally be green for G seconds, yellow lights will last for Y seconds. A red light will remain red for R seconds before the traffic is allowed to change direction.
- Traffic sensors may be present to detect car arrivals and departures.
- Pedestrian crossing request buttons may be present. After a button is pressed, the pedestrian should wait no longer than C seconds for permission to cross.

Using a block diagram, demonstrate the input and output devices of the system.

[3 marks]

b) You were selecting a temperature sensor in a hardware store for your project. One of the temperature sensors provides the following information:

i. The sensor can measure temperature between 10 to 60°C.
ii. The sensor can detect up to 0.01°C change of temperature.
iii. The variation of sensor's output range between ±0.001°C.
iv. The sensor has good tolerance in all measurement conditions.
v. The sensor is not subjected to a sinusoidal frequency change.

Classify each information based on **FIVE (5)** selection criteria for sensors.

[2.5 marks]

c) At any given time, only one task can run in a computer that has only one processor. Other tasks must be in some state other than running.

Illustrate the transitions of a task among the **FIVE (5)** states.

[4.5 marks]

Continued...

Question 3 [10 marks]

a) Identify which kernel design is suitable for the following situations:

i. A system that requires implementation of a combination of various real-time kernel designs.
ii. A system that requires "fairness scheduling".
iii. A system that needs to handle high-speed channels.
iv. A system that can be coded in many languages using if-then statements.
v. A system that has tasks with various priority levels.

[2.5 mark]

b) Scheduling involves the allocation of resource and time to tasks in such a way that certain performance requirements are met. Several scheduling classes emerge, depending on:

i. Whether a system performs schedulability analysis.
ii. If it does, whether it is done statically or dynamically.
iii. Whether the result of the analysis itself produces a schedule or plan according to which tasks are dispatched at run-time.

Using the above factors, discuss **FOUR (4)** classes of scheduling algorithms.

[4 marks]

c) Mailbox is best implemented in systems that used task-control block model with a supervisor task. Mailbox requires **TWO (2)** tables to be implemented at coding level.

i. Explain the roles of these tables.
ii. Identify the types of data that can be passed via mailboxes.

[3.5 mark]

Continued...

Question 4 [10 marks]

a) Design the timing constraints for the following air-defense system. Classify each constraint into either performance or behavioral constraint.

> *The wash-machine waits for the 'start' switch to be pressed. After the user presses the 'start' switch, the machine fills the wash tub with water. The water filling continues until the high level is sensed. The machine starts the agitation motor and continues agitating the wash tub until either the preset timer expires. After the agitation stops, the machine waits for the user to press the 'startDrying' switch. After the user presses the 'startDrying' switch, the machine starts the hot air blower and continues blowing hot air into the drying chamber until the user presses the 'stop' switch.*

[6 marks]

b) Compose a Petri Net representation for the following mathematical equation:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

[4 marks]

Question 5 [10 marks]

a) Describe **THREE (3)** attributes of system dependability.

[3 marks]

b) Fault tolerance is the ability of the system to continue to function in the presence of hardware or software failures. Explain **THREE (3)** levels of fault tolerance.

[3 marks]

c) Describe the **FOUR (4)** phases in software dynamic redundancy.

[4 marks]

End of Paper.